MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2015/2016

BMP2014 – MATHEMATICAL PROGRAMMING

(All sections / Groups)

1st MARCH 2016
2.30 p.m. - 4.30 p.m.
(2 Hours)

INSTRUCTIONS TO STUDENT

1. This question paper consists of **FOUR (4)** printed pages with **4** questions.
2. Answer **ALL** questions.
3. Write your answers in the answer booklet provided.
4. All necessary workings **MUST** be shown.

Question 1 (25 marks)

(a) The production manager for the Inersia Company is scheduling hourly production levels for three products: Rho, Sigma and Theta. Each product is processed through three departments: fabrication, assembling and packaging. The following table indicates the time required to process a unit of the product in each department, the total production time available during each hour of operation and the profit margins for each product.

Department	Processing Time			Available Production Time
	Rho	Sigma	Theta	
Fabrication	1.00	1.20	1.25	1,200
Assembly	1.30	1.50	1.60	1,500
Packaging	0.80	0.75	0.90	950
Profit/ unit	$ 0.55	$ 0.77	$ 0.75	

The management has specified minimum unit production levels for Rho and Sigma of 200 and 250, respectively. Also, no more than 225 units of Theta should be produced each hour. The production manager wishes to determine the number of units of products to schedule each hour so as to maximize total profit.

Formulate a linear programming (LP) model for the problem above. Do not solve the LP.

[10 marks]

(b) Consider the following LP:

$$\begin{aligned} \text{Maximize} \quad & Z = x_1 + 2x_2 \\ \text{subject to} \quad & -x_1 + x_2 \le 2 \\ & -2x_1 + x_2 \le 1 \\ & x_1 \ge 0, x_2 \ge 0 \end{aligned}$$

Apply the simplex method and show that the LP is unbounded.

[15 marks]

Continued...

Question 2 (25 marks)

(a) Graphically solve the following LP model and state your findings.

$$\begin{aligned} \text{Minimize} \quad & Z = 3x_1 + 5x_2 \\ \text{Subject to} \quad & x_1 + 2x_2 \le 15 \\ & 5x_1 + x_2 \le 20 \\ & x_1 + x_2 \ge 25 \\ & x_1 \ge 0, x_2 \ge 0 \end{aligned}$$

[5 marks]

(b) Use the Two-Phase Simplex Method to find the optimal solution of the following LP problem:

$$\begin{aligned} \text{Minimize} \quad & Z = 4x_1 + x_2 \\ \text{Subject to} \quad & 3x_1 + x_2 = 3 \\ & 4x_1 + 3x_2 \ge 6 \\ & x_1 + 2x_2 \le 4 \\ & x_1, x_2 \ge 0 \end{aligned}$$

[20 marks]

Question 3 (25 Marks)

(a) Use the dual simplex method to solve the following LP:

$$\begin{aligned} \text{Maximize} \quad & Z = -x_1 - x_2 - x_3 \\ \text{Subject to} \quad & x_1 + x_2 \ge 4 \\ & x_2 + x_3 \ge 5 \\ & x_1 \ge 0, x_2 \ge 0, x_3 \ge 0 \end{aligned}$$

[5 marks]

Continued...

(b) Consider the following LP problem,

$$\begin{aligned} \text{Minimize} \quad & D = 2x_1 + x_2 + 2x_3 \\ \text{Subject to} \quad & x_1 + x_2 + x_3 \geq 6 \\ & 2x_1 + 3x_2 + 10x_3 = 24 \\ & x_1 \geq 0, x_2 \geq 0, x_3 \geq 0 \end{aligned}$$

and its optimal tableau,

D	x_1	x_2	x_3	s_1	a_1	a_2	RHS	BV
1	-8/5	-2/5	0	0	-1	(-5M+1)/5	24/5	D = 24/5
0	1/5	3/10	1	0	0	1/10	12/5	x_3 = 12/5
0	-2/5	-1/10	0	1	-1	3/10	6/5	s_1 = 6/5

From the given LP, find the dual LP and its optimal solution. **[8 marks]**

(c) Consider the following NLP:

$$\text{Minimize} \quad f = -x_1^2 - 6x_2^2 - x_3^2 + 3x_1x_2 + 3x_2x_3$$

i. Determine whether the function is a concave, convex or neither concave nor convex function.

ii. Find the exact optimal solution, if any.

[12 marks]

Continued...

Question 4 (25 Marks)

(a) The Élite Furniture Corporation manufactures dinner tables at three locations: Detroit, Evansville, and Fairfield. The firm distributes the tables through regional warehouses located in Boston, Austin, and Cleveland. Estimates of the monthly production capacity of each factory and the tables needed at each warehouse are stated in the following table:

FROM	To			Supply
	Boston	Austin	Cleveland	
Detroit	\$5	\$20	\$5	40
Evansville	\$10	\$30	\$8	40
Fairfield	\$10	\$20	\$12	40
Demand	45	50	40	

Use the Northwest Corner method and the minimum-cost method to find the basic feasible solution for the problem.

[13 marks]

(b) Use the Hungarian method to find the optimal solution for the assignment problem with the following cost table:

	I	II	III	IV	V
A	11	17	8	16	20
B	9	7	12	6	15
C	13	16	15	12	16
D	21	24	17	28	26
E	14	10	12	11	15

[12 marks]

End of Page.